academicJournals

Vol. 10(24), pp. 2460-2469, 11 June, 2015
DOI: 10.5897/AJAR2015.9536
Article Number: 0D07A6553369
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Factors influencing smallholder farmers' access to agricultural microcredit in Northern Ghana

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Received 22 January, 2015; Accepted 20 May, 2015

This paper explores access to agricultural microcredit in Ghana using household survey data collected for the 2013/2014 farming season. The study approaches the access to microcredit from two angles pertaining to the factors influencing access to loan and when accessed, the determinants of loan size. Since these two choices are related, the Heckman selection model was chosen as the analytical tool for addressing the possible presence of sample selectivity bias in the loan size regression. A multi-stage stratified random sampling technique was used to select 300 smallholder rice farmers from three irrigation schemes in Northern Ghana who were interviewed using a semi-structured questionnaire. The study revealed that the following factors influence access to agricultural microcredit in Northern Ghana: gender, household income, farm capital, improved technology adoption, contact with extension, the location of the farm, and awarenes s of lending institutions in the area. Gender, household size, farm capital, cattle ownership and improved technology adoption were the significant factors determining loan size. The study recommends the improvement of extension service delivery to smallholder farmers to enable them to access microcredit facilities for agricultural production.

Key words: Agricultural microcredit, binary probit model, Heckman selection model, loan size, Northern Ghana, smallholder farmers.

INTRODUCTION

This paper explores access to agricultural microcredit in Ghana by applying Heckman's sample selection model to a household survey data collected for the 2013/2014 farming season. Access to agricultural microcredit remains a critical challenge to smallholder farmers in many developing countries including Ghana. This is because smallholder farmers often require small loans which are difficult to administer while majority of them also lack the needed collateral to be able to borrow from formal sources. Where collateral requirements are met, the sheer size of potential borrowers always seems to exclude others from borrowing. Consequently, smallholder farmers have been marginal participants in the credit market in many developing countries. As noted by Dittoh (2006), access to credit is the topmost priority of smallholder farmers in Northern Ghana where agriculture is the main economic activity.

The agricultural sector in most developing countries

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including Ghana contribute immensely to employment, income generation, gross domestic product (GDP), foreign exchange earnings, and food security. The sector plays a pivotal role in the rural economy and economic development in general. The important role of agriculture in the economies of developing countries calls for an increase in investments in the sector to increase production.

As reported by Reyes (2012), rural development and, in particular, farm productivity, can be influenced by several factors including access to credit. Agricultural credit accelerates agricultural modernisation and economic development. It also creates and maintains adequate flow of inputs thus increasing efficiency in farm production (Nouman et al., 2013).

As noted by Omonona et al. (2010), access to credit enhances the production efficiency of small scale farmers thereby reducing rural poverty and food insecurity. Access to credit influences farm productivity since credit-constrained farmers are more likely to use lower levels of inputs in production compared to those who are not. Improving access to credit therefore has the capacity to facilitate optimal input use leading to a positive impact on productivity.

Smallholder farmers are defined as those marginal and sub-marginal farm households that own and/or cultivate less than 2.0 ha of land (Singh et al., 2002). According to Nwanze (2011) there are about 500 million smallholder farms worldwide, providing livelihoods for more than 2 billion people. These small farms produce about 80% of the food consumed in Asia and sub-Saharan Africa, showing the importance of the small farm sector to agricultural and economic development in many developing countries.

The small farm holdings in most developing countries contrast significantly with what pertains in most developed countries. While farms are becoming fewer and bigger in developed countries, they are becoming more and smaller in most developing countries. Low investment in the agricultural sector has limited farm expansion in most developing countries. However the main determinant of farm size according to Deininger and Byerlee (2012) is the rise of off-farm wages. As noted by the authors, a rise in off-farm wages drives farm size up. What determines farm sizes is the number of people willing to engage in farming as well as the opportunity for good paying jobs outside the farm sector.

In places where there are many people to cultivate the land but fewer opportunities for good paying jobs outside the farm sector, we have labour-intensive and land-saving agriculture. Farm sizes therefore tend to be smaller. In every generation, farms split to accommodate new children.

On the contrary, in places where good paying job opportunities exist outside farming, fewer people tend to farm larger land areas using labour-saving technologies like machinery and inorganic chemicals. The structural development in agriculture in both types of economies may also be accounted for by the opportunity cost of labour and capital.

Analysis of the factors influencing smallholder farmers' access to microcredit has been carried out by various researchers such as Sebopetji and Belete (2009), Sanusi and Adedeji (2010), Duy et al. (2012), Ibrahim and Aliero (2012), Chauke et al. (2013) and Nouman et al. (2013). Very few researchers such as Duy et al. (2012) have analysed access to credit taking into account the possible presence of selectivity bias arising from non-random sampling of borrowers and non-borrowers. Similar analyses are difficult to find for Ghana and most sub-Saharan countries.

This present study therefore attempts to build on previous studies by taking into account the problem of selectivity bias. Another important aspect of this present study is the inclusion of production system (irrigation dummy) as an additional explanatory variable to explain access to agricultural microcredit. The study approaches the issue of access to microcredit from two angles pertaining to the discrete choice of access to loan (microcredit) and the continuous choice of loan size. Since these two choices are related, the Heckman selection model was chosen as the analytical tool for addressing the possible presence of sample selectivity bias in the loan size regression.

MATERIALS AND METHODS

Here presents the analytical framework and empirical models for the study, the study area and sampling procedure, and a description of the variables used in the study.

The Probit Model

Probit analysis was developed in response to the need to analyze dichotomous dependent variables within the regression framework. Many response variables are binary by nature, requiring either a yes or no (or 1/0) response. Ordinary least squares (OLS) regression has been shown to be inadequate when we have dependent variables that are discrete (Agresti, 1990; Collett, 1991). Probit and logit analyses become more appropriate when dealing with such situations.

The probit model constrains the estimated probabilities to lie between 0 and 1. It also relaxes the constraint that the effect of the independent variable is constant across different predicted values of the dependent variable. The probit specification has advantages over logit models in small samples. The probit model makes the assumption that while we only observe the values of 0 and 1 for the dependent variable Z_i, there is a latent, unobserved continuous variable Z_i^* that determines the value of Z_i (Sebopetji and Belete, 2009). For this study, the probit model is preferred and used to examine the determinants of farmers' access to agricultural microcredit in Northern Ghana.

Suppose the response variable Z_i is binary with only two possible outcomes denoted as 1 and 0. Consider also a vector of regressors x_i, which are assumed to influence Z_i. Specifically we assume that the model takes the form:

$$\Pr(Z_i = 1 | x_i) = \Phi(x_i'\gamma) \quad (1)$$

Where Pr denotes probability, Z_i is the binary choice variable, that is access to microcredit and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. γ is a vector of unknown parameters.
It is assumed that Z^* can be specified as follows:

$$Z_i^* = \gamma_0 + \sum_{n=1}^{N} \gamma_n x_{ni} + u_i \quad (2)$$

And that:

$$Z_i = 1_{if Z_i^* > 0} \text{ and } Z_i = 0_{Otherwise} \quad (3)$$

Where x_i represents a vector of explanatory variables, γ is a vector of unknown parameters and u_i is a random disturbance term. N is the total sample size. The unknown parameters are estimated by the method of maximum likelihood.

Heckman selection model

In using the Heckman selection model, we first estimated the probability of households having access to agricultural microcredit. Next, we estimated the impact of access to microcredit on loan size while accounting for the possible presence of selection bias using Heckman's two-stage regression model.

The problem of non-participation in credit scheme can be approached as an issue of sample selection bias (Heckman, 1979). Being able to borrow and the inability to borrow represent sub-samples of the entire households. Sampling based on the categorisation of respondents into borrowers and non-borrowers can yield a non-random sample. For example, exclusion from borrowing and non-willingness to borrow can result in select samples (sample selection bias). In other words, those households who were able to access credit could be different from those who lacked access. Heckman devised a two-stage estimation method that yields consistent parameter estimates (Heckman, 1979). Heckman's two-stage method treats the censored sample problem as a specification error. Heckman showed that it is possible to correct for the above problem by first estimating an omitted variable λ_i.

This omitted variable is consistently estimated as the inverse Mill's ratio (IMR) using a probit analysis. Thus the first stage of the Heckman two-stage estimation method is to obtain consistent estimates of the parameters (independent variables as well as λ_i), by maximising the log-likelihood function of the probit model of access to credit. In the second stage of estimation, the estimated λ_i is used as an additional regressor in an ordinary least squares (OLS) regression of Y_i on the explanatory variables w_i for all cases where the selection equation equals one, that is, for those households which had access to microcredit ($Z_i > 0$). The parameters obtained from the second stage are consistent and asymptotically normal. A significant inverse Mill's ratio shows that selection bias is present. The Heckman two-stage selection model was estimated simultaneously in one procedure using Stata Version 13. The decision by a household to take a loan has been shown to be influenced by a number of household characteristics and can be represented by the following equation:

$$Z_i^* = \boldsymbol{\gamma}' \mathbf{x}_i + u_i \quad (4)$$

Where Z_i^* is a dummy variable representing household access to microcredit. Hence Equation (4) measures the probability that the i^{th} household has access to microcredit. $\mathbf{x}_i$ is a vector of exogenous household variables affecting Z_i^*. Z_i^* is unobservable, but we can observe if a household had access to microcredit or not. $\boldsymbol{\gamma}$ refers to the parameters to be estimated.
Household characteristics have also been shown to influence the size of loan that households will take. Hence in the second stage of estimation, loan size is regressed on various household characteristics. Given that $Z_i = 1$, we have the following:

$$Y_i = \boldsymbol{\beta}' \mathbf{w}_i + v_i \quad (5)$$

Where Y_i represents the loan size expectedly received by each household, $\mathbf{w}_i$ is the vector of variables which determine loan size, and $\boldsymbol{\beta}$ refers to the parameters to be estimated.
In Equations (4) and (5), u_i and v_i have bivariate normal distributions with zero means, standard deviation δ_u and δ_v, and they are correlated with correlation coefficient ρ (Duy, 2011). It is assumed that Z_i and x_i are both observable for a random sample of individual households. However, Y_i is observed only when the household has access to credit ($Z_i = 1$). From Heckman (1979), the expected loan size equation may be formulated as follows:

$$\begin{aligned} &E(Y_i \mid Z_i = 1) = E(Y_i \mid Z_i^* > 0) = E(Y_i \mid u_i > \boldsymbol{\gamma}' \mathbf{x}_i) \\ &= \boldsymbol{\beta}' \mathbf{w}_i + E(\mathrm{v}_i \mid u_i > \boldsymbol{\gamma}' \mathbf{x}_i) = \boldsymbol{\beta}' \mathbf{w}_i + \beta \sigma_v \lambda_i(\alpha_u) \end{aligned} \quad (6)$$

Where:

$$\lambda_i(\alpha_u) = \frac{\varphi(\alpha_u)}{1 - \phi(\alpha_u)} = \frac{\varphi(-\alpha_u)}{\phi(\alpha_u)} = \frac{\varphi(\boldsymbol{\gamma}' \mathbf{x}_i / \alpha_u)}{\phi(\boldsymbol{\gamma}' \mathbf{x}_i / \alpha_u)} \quad (7)$$

And φ and ϕ are the normal density function and normal distribution function respectively. The function $\lambda_i(\alpha_u)$ is referred to as the inverse Mill's ratio. A least squares regression of Y_i on $\mathbf{w}_i$ without the inverse Mill's ratio [$\lambda_i(\alpha_u)$] will produce inconsistent estimators of β. A possible solution to this problem is to include the expected value of the error term, if it is known, in the regression as an additional explanatory variable thereby removing that part of the error which is correlated with the explanatory variables, thus avoiding the inconsistency. However, the error term cannot be estimated (it is unknown). As a result, the inverse Mill's ratio must be computed and included in the estimation of the outcome or loan size equation (Equation 5).

Choice of exclusion variables in the Heckman model

The application of the Heckman model requires the exclusion of at least one variable in the selection equation from the outcome

equation due to the identification criteria. For the present study, the regional dummy, extension contact and farmers' awareness of lending institutions in the study area were selected as exclusion variables. We expected regional variations in the distribution of lending institutions to affect access to loans but not loan amounts. Similarly, awareness of lending institutions serving the needs of farmers in the area is expected to influence access to credit but not the size of loan. According to Gaih and Thapa (2006), lack of awareness excludes some potential beneficiaries from microfinance schemes. Thus participation in microcredit schemes is expected to be influenced by household's awareness of the lending institutions and opportunities for borrowing within their localities. Also, contact with extension increases farmers' knowledge and awareness including lending opportunities, but not necessarily their borrowing decisions.

Farming households in the study area access loans from diverse sources. The sources included rural banks, non-governmental agencies, government subsidized credit, moneylenders, friends and relatives. Collateral was omitted from the study because majority of the farmers did not need to provide it in order to borrow. In addition, interest rate was not included due to lack of data and the fact that some of the loans were interest-free. Other variables like association membership and distance to source of credit were excluded from the analysis because of their limited impact in explaining access to credit and loan size.

Study area

The study area is Northern Ghana, which comprises the Upper East, Upper West and Northern Regions. Ghana has a total land area of 238,540 km^2 and has a warm humid climate. There are six ecological zones namely the rain forest, the deciduous forest, the transitional zone, the Guinea Savannah, the Sudan Savannah, and the Coastal savannah. Rainfall distribution is bimodal for the forest, transitional and coastal zones resulting in two growing seasons, the major and the minor growing seasons. Conversely, the savannah zone which comprises the three Regions of Northern Ghana has a mono-modal rainfall distribution which gives rise to only one cropping season.

Sampling and data collection

The data came from a farm household survey. A total of 300 respondents were selected from fifteen communities and interviewed using structured questionnaire which was pre-tested. A stratified multi-stage sampling technique was used. The three largest irrigation schemes in Northern Ghana were purposively sampled. These are the Tono Irrigation Scheme in the Kassena-Nankana District of the Upper East Region, the Vea Irrigation Scheme in the Bolgatanga District also in the Upper East Region, and the Botanga Irrigation Scheme in the Tolon-Kumbungu District of the Northern Region. Five communities were randomly selected from the catchment area of the three irrigation schemes. Rice farmers were stratified into irrigators and non-irrigators and equal samples of irrigators and non-irrigators were randomly selected.

Description of variables used in the study

Gender differences exist in most rural communities regarding access to resources hence sex of respondent is hypothesised to influence access to agricultural microcredit as well as loan size. Our *a priori* expectation is informed by the fact that men usually have social and political power and dominate in ownership and access to productive resources in most rural communities. Educational attainment also increases the knowledge about available opportunities including sources of funding, and may influence participation in agricultural projects as well as the choices that individuals make hence its inclusion in the study.

Age is an important variable in decision-making. The years of farming experience of the household head is hypothesised to influence both access to loan and the size of loan. This is because older farmers with years of farming experience are expected to be knowledgeable about farming and the various sources of credit. They are also expected to have better credit management skills and credibility with lenders.

Household size is another important household characteristic which influences many household decisions. Access to microcredit and the amount of loan borrowed are hypothesised to be influenced by the size of the farming household because it determines the household labour supply which is important for agricultural production. Households with limited labour supply may need to borrow to augment their labour supply while households with excess labour may not face such liquidity constraints. Household size can therefore ease the liquidity constraints of the household, thus influencing the decision to borrow as well as the loan amount.

Land size also plays a crucial role in farming decisions and was considered as an important variable in determining both access to microcredit and size of loan applied for. Households with small farm lands may not need to borrow to finance their production or may only need small loans. However households with large farm lands may need more loans. Furthermore, households with large farm lands may be wealthier or better-off in the community and this can influence their access to credit. Lenders are also more likely to give bigger loans to farmers with large farms compared to those with small farms.

Household income plays a role in the decision-making of the household regarding whether to seek loan for farming or not. As observed by Dodson (1997), demand for agricultural credit over the short term is influenced by income level and the need to replace capital stock. In rural communities, economic status, proxied by household income, plays a major role in participation in projects and access to resources. Hence the income of the household is hypothesised to influence both loan access and size. Poorer households may be considered as risky borrowers which can affect their loan access and amount borrowed.

The production system employed by the farmer, that is, whether the farmer uses irrigation or not, was hypothesised to influence access to credit and loan size. Irrigated rice farming permits intensification of farming and could lead to higher demand for credit. In addition, agricultural credit is seasonal in many rural areas so that farmers who farm during the dry season may have limited opportunities to borrow.

Farm capital of the household determines the capital stock of the household for agricultural purposes. Agricultural production usually involves the need to acquire or replace capital stock. Households endowed with large capital stock may have a lower propensity to borrow for capital replacement. On the other hand, capital-endowed households may be innovative farmers who may like to borrow more to expand their operations. Farm households with little capital endowment may be considered too poor and may not be considered creditworthy by some lenders.

Cattle ownership is hypothesised to influence credit access and size. This is because cattle ownership is an indicator of wealth in most rural communities. Farm households with cattle are more likely to receive access to credit as well as more loans compared to poorer households because owners of cattle may be perceived to be creditworthy. On the other hand, cattle owners may be less cash-constrained and as such may turn to borrow less.

Technology adoption is hypothesised to positively influence both access to credit and loan size. This is because adoption of improved technology usually implies higher production cost which requires additional capital injection making adopters of improved technologies more likely to demand credit as well as bigger loan

Table 1. Distribution of borrowers and non-borrowers in the sample.

Region	Borrowers	Non-borrowers	Total
Northern Region	55	45	100
Upper East Region	66	134	200
Total	121	179	300

amounts. Forty percent of the credit disbursed to the respondents in the study was in kind, in the form of improved seeds and fertilizer. Hence the adoption of improved technology (high yielding crop varieties) is hypothesised to have a positive influence on credit access and loan amounts. Contact with extension agents is also expected to influence farmers' choices and decision-making. In addition, farmers obtain valuable information on production practices and access to farm inputs from extension agents. The variable is therefore hypothesised to have a positive influence on the decision to access microcredit but not on loan size.

The regional dummy variable was included to capture differences that may exist between farmers in the two regions under investigation. Regional variation in the distribution of lenders or the establishment of lending institutions can affect access to credit, hence the choice of the variable.

Awareness of available lending institutions operating in the study area was hypothesised to influence farmers' access to microcredit. Awareness in this study is defined as being aware of or having information regarding the presence of lending institutions in the area. Farmers often prefer seasonal credit from governmental and non-governmental sources because such loans are often heavily subsidised. However, due to poor information flow, rural farmers may be unaware of the existence of such institutions thus affecting their access to credit. This point is noted by Gaih and Thapa (2006), who reported that some potential beneficiaries are excluded from microfinance schemes due to lack of awareness.

The authors noted that the reasons underlying exclusion of some groups from microfinance schemes include lack of awareness among potential beneficiaries, elaborate and time-consuming procedures, as well as social resistance.

The empirical model of the probit analysis (selection equation)

The probit model for the study was specified as follows:

$$Z_i = \gamma_0 + \sum_{n=1}^{13} \gamma_n x_{ni} + u_i \quad (8)$$

Where Z_i = access to credit (=1 if farmer had access to credit, 0 otherwise); x_1 = sex of respondent; x_2 = education: 1 if farmer had formal education, 0 otherwise; x_3 = farming experience; x_4 = household size; x_5 = total land size; x_6 = household income; x_7 = production system: 1 if irrigation, 0 otherwise; x_8 = farm capital; x_9 = cattle ownership: 1 if farmer had cattle, 0 otherwise; x_{10} = technology adoption: 1 if farmer adopted high yielding rice variety, 0 otherwise; x_{11} = extension contact: 1 if contact was made, 0 otherwise; x_{12} = regional dummy: 1 if in Northern region, 0 otherwise; x_{13} = awareness of lending institutions in the area: 1 if aware, 0 otherwise.

The empirical model of the outcome equation (loan size)

$$Y_i = \beta_0 + \sum_{j=1}^{10} \beta_j w_{ji} + v_i \quad (9)$$

Where Y_i = loan size; w_1 = sex of respondent; w_2 = education: 1 if farmer had formal education, 0 otherwise; w_3 = farming experience; w_4 = household size; w_5 = total land size; w_6 = household income; w_7 = production system: 1 if irrigation, 0 otherwise; w_8 = farm capital; w_9 = cattle ownership: 1 if farmer had cattle, 0 otherwise; w_{10} = technology adoption: 1 if farmer adopted high yielding rice variety, 0 otherwise.

RESULTS AND DISCUSSION

The following gives the empirical results of our study and a discussion of the main findings.

Distribution of borrowers and non-borrowers in the sample

Table 1 shows the distribution of borrowers and non-borrowers in the sample. Forty percent of the respondents had access to microcredit. Hence, majority of smallholder farmers in the study area lack access to microcredit for agricultural production, and this represents a serious drawback to agricultural production in the area. As noted by Dittoh (2006), access to credit remains the foremost priority of most smallholder farmers in Northern Ghana.

General characteristics of households in the study sample

Table 2a and b compare the household characteristics of borrowers and non-borrowers of agricultural microcredit in the study sample. Households who were borrowers had bigger land sizes, more years of farming experience, as well as higher household income and farm capital compared to non-borrowers and the overall sample average. Borrowers also had more household members compared to non-borrowers and the sample average.

Table 2a. The independent variables for rural household's access to microcredit.

Variable	Borrowers (N=121)	Non-borrowers (N=179)	Overall (N=300)
Farming experience (years)	16.7	14.5	15.4
Total land size (acres)	7.05	4.79	5.70
Household income in Ghanaian cedi	2796	2073	2364
Farm capital in Ghana cedi	728	493	588
Household size	10.3	9.20	9.65

Table 2b. The independent variables for rural household's access to microcredit.

Variable	Borrowers (N=121)	Non-borrowers (N=179)	Overall (N=300)
Extension contact (%)	71.90	57.54	63.33
Access to irrigation (%)	50.41	49.72	50.00
Educational status (%)	41.32	44.69	43.33
Cattle ownership (%)	37.19	31.29	33.67
Technology adoption (%)	58.68	72.07	66.67
Awareness of lending institutions (%)	91.74	74.30	81.33
Region (1 = Northern Region) (%)	45.45	25.14	33.33
Awareness of lending institutions (%)	91.74	74.30	81.33
Gender (1 = male; 0 otherwise) (%)	75.21	80.45	78.33

Non-borrowing households had the least of these characteristics in comparison to borrowers and the overall sample average. Contact with extension agents was higher for borrowers compared to non-borrowers (Table 2b). Borrowers also had greater awareness of the existence of lending institutions in the area. Also, there were more men than women in both borrower and non-borrower categories while access to irrigation was not different for borrowers and non-borrowers. The percentage of educated farmers among the non-borrower group was marginally higher than for the borrower group. Hence education does not seem to vary much between the two groups which could suggest a weak influence of formal education on access to microcredit in the study area.

Educated farmers may have other sources of income apart from farming, which may affect the decision to borrow. Also, cattle ownership was higher for credit borrowers indicating that cattle ownership could influence access to credit. The proportion of non-borrowers who adopted improved rice technology was higher than that of borrowers which is contrary to our expectation. We expected a greater percentage of borrowers to be improved technology users. Finally, a greater percentage of farmers in the Upper East Region had access to credit compared to their counterparts in the Northern Region.

Loan characteristics by region

Table 3 shows the loan characteristics of the respondents in the study sample. On average, farmers in the Northern Region took larger loans compared to those in the Upper East Region. The average loan size of borrowers in the Northern Region also exceeded the sample average while for the Upper East Region, the average loan size was below the sample average.

About 45% of borrowers in the Northern Region received loan in cash compared to 67% in the Upper East Region. Loan in kind was received by 49% of borrowers in the Northern Region compared to 32% in the Upper East region. A very small number of households received loan both in kind and in cash.

In terms of source of credit, formal sources accounted for 54% of all loans with the rest coming from informal sources. Formal sources included commercial banks, non-governmental organizations and government programs offering credit to farmers. The informal sources included money-lenders, friends and relatives. Households who borrowed from formal sources in the Northern and Upper East Regions were 55 and 53% respectively. Hence the source of agricultural microcredit followed a similar pattern in both regions.

Eighty-one percent of borrowers used the loans to buy farm inputs. About 31% of borrowers in the Northern Region used the credit for farm expansion while none did so in the Upper East Region. Table 4 shows the distribution of the loan size received by respondents. The amount of loan received by households ranged from GH¢10.00 to GH¢1000.00, with a mean of GH¢246.00. Thirty-seven percent of households borrowed not more than GH¢100.00, while 57% borrowed up to GH¢200.00.

Table 3. Loan characteristics by region.

Loan characteristic	Northern Region (N=55)	Upper East Region (N=66)	Overall (N=121)
Loan amount (GH¢)	307	195	246
Loan type:			
- Cash	25	44	69
- In kind	27	21	48
- Both	3	1	4
Source of credit			
- Formal	30	35	65
- Informal	25	31	56
Purpose of loan			
- Buy farm inputs	36	62	98
- Farm expansion	17	0	17
- Other	2	4	6

Table 4. Distribution of loan size received by rural households in Northern Ghana.

Loan size (GH¢)	Frequency	Percentage	Cumulative (%)
0 – 100	45	37.2	37.2
101 – 200	24	19.8	52.0
201 – 300	21	17.4	74.4
301 – 400	9	7.45	81.8
401 – 500	10	8.26	90.1
501 – 600	5	4.14	94.2
601 – 700	3	2.47	96.7
701 – 800	2	1.66	98.4
801 – 900	0	0	98.4
901 – 1000	2	1.65	100
Total	121	100	100

Households who took more than GH¢500.00 but not exceeding GH¢1000.00 constituted 10% of the sample. Hence the majority of respondents were micro-loan borrowers.

Determinants of access to microcredit by rural households

Table 5 presents the results of the selection (probit) and outcome equations of the Heckman model of the factors influencing farmers' access to microcredit and loan size in Northern Ghana. Gender had a negative and highly significant relationship with access to microcredit indicating that women were more likely to receive loans compared to men.

The result agrees with Khalid (2003) and Ololade and Olagunju (2013) who reported a negatively significant relationship between gender and access to credit, with women being more likely to have access to credit. The finding is consistent with the assertion by Jazairy et al. (1992) that women are more credit-worthy and have higher loan repayment rates compared to men. There is increasing recognition of the significant contribution of women to agriculture in sub-Saharan Africa and other parts of the world resulting in some lending institutions targeting women farmers.

A positively significant relationship was observed between household income and access to microcredit (at the 5% level). This indicates that farmers with higher incomes are more likely to have access to agricultural loans compared to those with lower farm incomes. The result is expected because access to resources in rural communities is usually influenced by social, economic and political power. High income households have economic power and that can inure to their advantage when applying for loans. Very poor households may be considered as risky borrowers by some lenders. In addition, high income households may be innovative farmers who rely on external finance to expand their

Table 5. Results of the probit and outcome equations of the Heckman Selection Model of access to agricultural microcredit.

Independent variables	Probit		Outcome	
	Coefficient	P-value	Coefficient	P-value
Sex	-0.604	0.006***	75.20	0.094*
Education	0.082	0.639	12.03	0.737
Farming experience	0.013	0.122	2.231	0.163
Household size	-0.025	0.117	6.825	0.034**
Land	0.012	0. 584	5.070	0.145
Household income	0.246	0.026**	1.921	0.924
Production system	-0.254	0.150	41.83	0.216
Farm capital	0.098	0.062*	19.31	0.053*
Cattle ownership	0.064	0.757	-77.55	0.059*
Technology adoption	-0.434	0.017**	63.94	0.072***
Extension contact	0.660	0.001***		
Regional dummy	1.377	0.000***		
Awareness of MFIs	1.070	0.000***		
Constant	-1.624	0.000***	-79.81	0.254
Inverse Mill's Ratio (λ)			-126.3	0.014**
Rho	-0.661			
Sigma	191.0			
Number of observations			300	
Censored Observations			179	
Uncensored Observations			121	
Wald chi2(10)			39.2	
Prob> chi2			0.00	

***, ** and * indicate statistical significance at the 1, 5 and 10% level, respectively.

farms.

The coefficient on farm capital had a positive and significant relationship with access to microcredit at the 10% level of significance. The result is consistent with Duy et al. (2012) who found that a household's capital endowments are very important in the demand for formal credit as well as loan amount. Smallholder farmers are usually resource-poor and have little capital endowment. An increase in farm capital therefore could indicate that the farmer is better-off economically or an innovator which could facilitate access to credit.

Technology adoption was negatively and significantly related to access to credit (at the 5% level) which was contrary to our *a priori* expectation. The result indicates that improved rice variety adopters were less likely to have less access to loans compared to non-adopters. The results have important implications for rice production because adopters of improved variety need access to financial services to purchase inputs needed to enhance their production.

It is important to note that access to credit in rural communities may be influenced by other reasons apart from those considered rational from an economic point of view. For example, Akudugu (2012) found that political affiliation was a significant determinant of credit demand by farmers in the Upper East Region of Northern Ghana.

Extension contacts had a positive and highly significant relationship with access to microcredit indicating that extension service delivery enhances accessibility to microcredit. The result is expected because extension agents are important source of information for many rural farmers. Extension agents also help to link farmers' groups to credit sources. Thus extension contact is expected to positively impact access to microcredit. The result agrees with Muhongayirea et al. (2013) and Sanusi and Adedeji (2010) who reported a positively significant relationship between extension contact and access to formal credit in Rwanda. Efforts to improve access to agricultural microcredit to smallholder farmers must therefore take into consideration the improvement of extension service delivery to farmers.

The location of the household exhibited a positive and highly significant relationship with access to microcredit. The result implies that regional differences exist in smallholder farmers' access to agricultural microcredit in the study area with farmers in the Northern Region being more likely to have access to microcredit than those in the Upper East Region. Regional disparities in the distribution of lending institutions as well as other unobserved regional disparities could account for the

regional differences in access to microcredit.
Finally, the coefficient on farmers' awareness of lending institutions in the area exhibited a positive and highly significantly relationship with access to microcredit. This shows that awareness increases the probability of accessing loan, which is in agreement with our *a priori* expectations. According to Gaih and Thapa (2006), lack of awareness can result in some potential beneficiaries being excluded from microfinance schemes and this was the case with our sampled respondents. Lack of awareness may arise because of poor information flow among farmers or non-participation in farmer-based organisations.

Determinants of loan size

Gender had a positive and significant relationship with loan size (at the 10% level) indicating that male farmers are more likely to borrow larger loan amounts compared to female farmers (Table 5). The result is expected because men usually own larger farm lands compared to women and are therefore expected to borrow larger amounts for agricultural purposes. In most rural communities, men usually have social and political power, and control most of the household resources. Consequently, men take most of the household decisions including the decision to borrow while women's loan decisions often need the approval of their husbands.

The coefficient on household size was found to be positive and significant at 5% level indicating that an increase in household size increases the amount of loan borrowed by the household. A possible explanation is that households with more members have a greater labour force for agricultural work as well as more members to feed. So in an effort to maximize output to meet family needs, such households are likely to take more loans to meet their production targets. Generally, smaller farm households are more likely to borrow less because of the limited number of members to take care of. Smaller farm households may also be considered too poor by lenders as a large household size is often associated with higher social and economic standing in most rural communities.

The coefficient on farm capital was positive and significant at the 10% level. The result shows that households with farm capital endowment are more likely to take more loans. These households could be innovative farmers who want to maximize their production. Ibeleme et al. (2013) found that assets holding positively influenced loan size of smallholder oil palm processors in Nigeria. Farmers with greater farm capital endowment may be operating on a relatively larger scale which may require additional borrowed funds to meet production costs. It is expected that farmers will borrow to augment or replace capital stock. In many poor communities, very poor farmers lack the ability to borrow. Under such situations, it is the relatively better-off farmers who tend to have access to loans and bigger loan amounts.

Cattle ownership showed a negative and significant relation with loan size at the 10 percent level implying that ownership of cattle tends to reduce the size of loans taken by farmers. The result is expected because cattle ownership is a good proxy for wealth in rural communities. Very wealthy households possess more cattle and very poor households do not often have cattle. The result seems to suggest that households possessing cattle are not cash-constrained compared to their counterparts who are non-cattle owners.

Adoption of improved technology was positively and significantly related to loan size at the 10 percent level. This shows that adopters of improved rice varieties take more loans than non-adopters. The result is consistent with our *a priori* expectation because technology adoption increases the production cost of farmers hence the need for more credit. Furthermore, adopters of improved technology are usually innovative or progressive farmers who are likely to explore the available opportunities for higher productivity.

As noted by Giné and Yang (2009), risk-averse borrowers may prefer to plant a traditional variety that does not require credit, to adopting an improved variety that is riskier. Hence among smallholder farmers, adopters of improved technology are expected to demand more loan amounts compare to non-adopters.
The inverse Mill's ratio (λ) was found to be significant at the 5% level implying that there was selectivity bias in the model. Using the Heckman two-step estimation procedure effectively corrected for the selectively bias thus the coefficients of the explanatory variables represent consistent estimates of loan size. In other words, the coefficients of the explanatory variables measure the pure effects of the independent variables on the dependent variable of the substantive equation (loan size). The negative sign of the inverse Mill's ratio implies that if selection bias had not been corrected in the model, the estimated coefficients would have been biased downwards.

CONCLUSION AND RECOMMENDATIONS

The study examined access to agricultural microcredit and determinants of loans size in Northern Ghana using the Heckman sample selection approach. The Heckman approach addresses the problem of sample selection bias thereby providing consistent parameter estimates. Access to microcredit is one of the important constraints facing farmers in Ghana.

The study revealed that access to agricultural microcredit in Northern Ghana was low with 40 percent of respondents having access to agricultural loans. Loan amounts were also very small, averaging GH¢246.00.

Regional differences were observed in smallholder farmers' access to microcredit. On average, farmers in the Northern Region had greater access to loans and also took larger loans compare to those in the Upper East Region.

Factors influencing smallholder farmers' access to agricultural microcredit in Northern Ghana include gender, household income, farm capital, improved technology adoption, extension contact, the location of the farm, and awareness of lending institutions in the area. Gender, household size, farm capital, cattle ownership and improved technology adoption were the significant factors influencing loan size. Furthermore, the study revealed that while women are more likely to have access to microcredit, men are more likely to take larger loans. From the study, individual household characteristics are therefore important in determining access to agricultural microcredit in Northern Ghana.

The study recommends the improvement of extension service delivery to farmers to enable them to access microcredit facilities for agricultural production. This is in line with the highly significant relationship between extension service delivery and access to agricultural microcredit in the study area. In addition, making credit available during the dry (off) season will increase accessibility to credit by irrigation-users. Furthermore, in order to enhance the adoption of improved varieties and technologies, and the ability of farmers to acquire and replace farm capital to improve production, there is the need to increase the provision of credit facilities to farmers. This is because the current low level of access to agricultural microcredit does not auger well for the modernisation of farming by smallholder farmers in the country.

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGEMENTS

The researchers acknowledge the following institutions for their financial support in carrying out the research: Wienco Ghana Ltd and Wienco Chair Research Committee of the Faculty of Agriculture of the University for Development Studies for providing funding for the research and the Nordic Africa Institute (NAI) in Sweden who provided a travel grant in support of the fieldwork.

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